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**Tropical Ecology and Society
Reconciling Conservation and
Sustainable Use of Biodiversity**

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O58-05 – S58 *Monitoring and mapping tropical biodiversity and ecosystem services with remote sensing*
Thursday 23 June / 10:30-12:00 – Sully I

Analysis of the potential of 10m resolution optical imagery for the monitoring of logging impacts on the forest cover in the Republic of Congo

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Background: Large areas of the African moist forests are being logged and little is known about the impacts on the forest and the related carbon emissions (Gourlet-Fleury et al. 2013). While logging roads can be persistent over time and captured in remote sensing derived products such as the Global Forest Cover Change (Hansen et al. 2013), the dynamic of associated openings in the canopy cover caused by skid paths, log decks and tree removal are not well documented due to temporal and spatial limitations of satellite images. The potential of the recently launched Sentinel-2a satellite to overcome those limitations and monitor small scale disturbances due to selective logging is investigated in this study.

Method: A unique time series of 10 m resolution satellite image is assembled from images acquired during the SPOT5-Take5 experiment complemented by the first Sentinel-2a acquisitions to monitor a certified selective logging concession in the Northern part of the Republic of Congo during the year 2015. Vegetation indices and a spectral un-mixing model are applied to the images in order to highlight gaps in the canopy. The satellite dataset is used to assess both the location and timing of logging activities by mapping the extent of canopy cover changes. The vegetation regeneration dynamics after logging events are assessed thanks to the high temporal frequency of image acquisitions.

Result and Discussion: Such imagery time series is suitable to monitor the temporal dynamics of logging roads and small disturbances in the forest cover related to wood extraction. We demonstrate that small openings in the forest canopy disappear in just a few months, underlining the requirement for high image acquisition frequency as provided by the Sentinel-2 mission. The resulting map of selective logged areas will be combined with field data to assess the area impacted on the ground. We will also investigate the possibility of linking such maps to measurements of wood extraction volume in the view of estimating changes in the Carbon stocks of logged forests over extended areas.

Additionally, the networks of logging roads will be analysed using a morphological spatial pattern software to compare the intensity of logging activities between this concession and a non-certified logging concession.

O58-06 – S58 *Monitoring and mapping tropical biodiversity and ecosystem services with remote sensing*
Thursday 23 June / 10:30-12:00 – Sully I

Bioclimatic envelope models predict a decrease in tropical forest carbon stocks with climate change in Madagascar.

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Recent studies have underlined the importance of climatic variables in determining tree height and biomass in tropical forests. Nonetheless, the effects of climate on tropical forest carbon stocks remain uncertain. In particular, the application of process-based dynamic global vegetation models have led to contrasting conclusions regarding the potential impact of climate change on tropical forest carbon storage.

Using a correlative approach based on a bioclimatic envelope model and data from 1771 forest plots inventoried during the period 1996-2013 in Madagascar over a large climatic gradient, we show that temperature seasonality, annual precipitation and mean annual temperature are key variables in determining forest above-ground carbon density.

Taking into account the explicative climate variables, we obtained an accurate ($R^2 = 70\%$ and $RMSE = 40 \text{ Mg.ha}^{-1}$) forest carbon map for Madagascar at 250 m resolution for the year 2010. This national map was more accurate than previously published global carbon maps ($R^2 < 26\%$ and $RMSE > 63 \text{ Mg.ha}^{-1}$).

Combining our model with the climatic projections for Madagascar from 7 IPCC CMIP5 global climate models following the RCP 8.5, we forecast an average forest carbon stock loss of 17% (range: 7-24%) by the year 2080. For comparison, a spatially homogeneous deforestation of 0.5% per year on the same period would lead to a loss of 30% of the forest carbon stock.

Our study shows that climate change is likely to induce a decrease of tropical forest carbon stocks. This loss could be due to a decrease in the average tree size and to shifts in tree species distribution, with the selection of small-statured species. In Madagascar, climate-induced carbon emissions might be, at least, of the same order of magnitude as emissions associated to anthropogenic deforestation.